The NASA Electronic Parts and Packaging (NEPP) Program – Field Programmable Gate Array (FPGA) Tasks/Considerations

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Outline

- **Acronym List**
- **Food For Thought**
- **Plans for FY14/FY15**
- **Recent Highlights**
- **Summary**

Acronyms

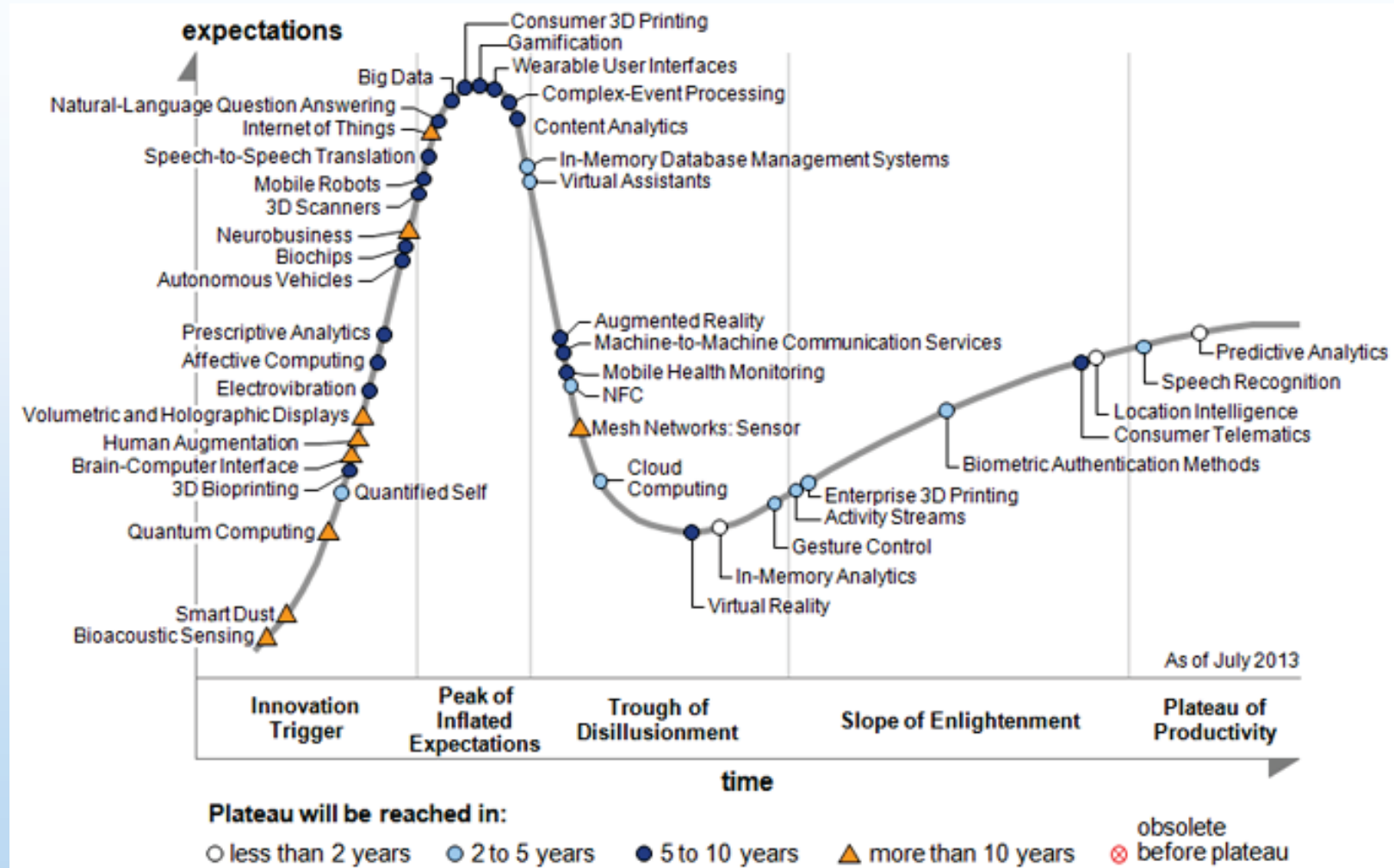| Acronym	Definition
3D	Three Dimensional
ADC	Analog to Digital Converter
Aero	Aerospace
AMRDEC	Aviation and Missile Research Development and Engineering Center
ARC	Ames Research Center
BME	Base Metal Electrode
BOK	Body of Knowledge
CALCE	Center for Advanced Life Cycle Engineering
CAVE	Center for Advanced Vehicle and Extreme Environment Electronics
CBRAM	Conductive Bridging Random Access Memory
CMOS	Complementary Metal Oxide Semiconductor
COP	Community of Practice
COTS	Commercial Off The Shelf
CSA	Canadian Space Agency
DAC	Digital to Analog Converter
DARPA	Defense Advanced Research Projects Agency
DC	Direct Current
DDR	Double Data Rate
DLA/DSCC	Defense Logistics Agency Land and Maritime
EEE	Electrical, Electronic, and Electromechanical
ELDRS	Enhanced Low Dose Rate Sensitivity
EPARTS	NASA Electronic Parts Database
ESA	European Space Agency
ETW	Electronics Technology Workshop
FET	Field Effect Transistor
FPGA	Field Programmable Gate Array
FY	Fiscal Year
G11	Component Parts Committee
G12	Solid State Devices Committee
GaAs	Gallium Arsenide
GaN	Gallium Nitride
GIDEP	Government Industry Data Exchange Program
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
HALT	Highly Accelerated Life Test
HiREV	High Reliability Virtual Electronics Center
HPL	High Performance Logic
IBM	International Business Machines
ICBM	Intercontinental Ballistic Missile
IP	Intellectual Property
JAXA	Japanese Space Agency
JEDEC	Joint Electron Device Engineering Council
JHU-APL	Johns Hopkins University Applied Physics Laboratory

Acronym	Definition
JPL	Jet Propulsion Laboratories
JSC	Johnson Space Center
KSC	Kennedy Space Center
LaRC	Langley Research Center
LEAP	Leading Edge Access Program
MDA	Missile Defense Agency
MEMS	Microelectromechanical Structure
MIL	Military
MLCC	Multi-Layer Ceramic Capacitor
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
MRQW	Microelectronics Reliability and Qualification Working Meeting
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NAVSEA	Naval Sea Systems Command
NEPAG	NASA Electronic Parts Assurance Group
NEPP	NASA Electronic Parts and Packaging
NFC	Near-Field Communication
NGC	Northrop Grumman Corporation
NPSL	NASA Parts Selection List
NRO	National Reconnaissance Office
NSP	National Space Programs
NSWC	Naval Surface Warefare Center
PBGA	Plastic Ball Grid Array
POF	Physics of Failure
POL	Point of Load
QML	Qualified Manufacturer List
RERAM	Resistive Random Access Memory
RF	Radio Frequency
SAE	Society of Automotive Engineers
SAS	Supplier Assessment System
SEE	Single Event Effects
SEU	Single Event Upset
SiC	Silicon Carbide
SMC	Space and Missile Command
SOC	Systems on a Chip
SW	Southwest
TI	Texas Instruments
TMR	Triple Modular Redundancy
TRL	Technology Readiness Level
TSMC	Taiwan Semiconductor Manufacturing Company
US	United States
USAF	United States Air Force
USN	United States Navy
VCS	Voluntary Consensus Standards
VNAND	Vertical NAND

To be presented by Kenneth A. LaBel at the NASA Electronic Parts and Packaging (NEPP) Electronics Technology Workshop, Greenbelt, MD, June 17-19, 2014.

Food For Thought –
Hype Cycle for Emerging Technologies

Source: Gartner August 2013

Where does your technology interest lie on the curve?

NEPP – FPGA Considerations

- **NEPP Tasks take two focuses:**
  - Support for developments in the Mil/Aero arena, and,
  - Evaluation of emerging commercial technologies.
- **Mil/Aero:**
  - Qualification: ensure that manufacturer claims meet product qualification requirements.
  - Aid manufacturers in understanding "vulnerabilities" in their new developments.
- **Commercial:**
  - Evaluate state-of-the-art devices keeping in mind application operating area for NASA usage.
- **Deliverables: guidelines, test reports, and technical papers.**
- **Task Leadership**
  - Radiation: Melanie Berg
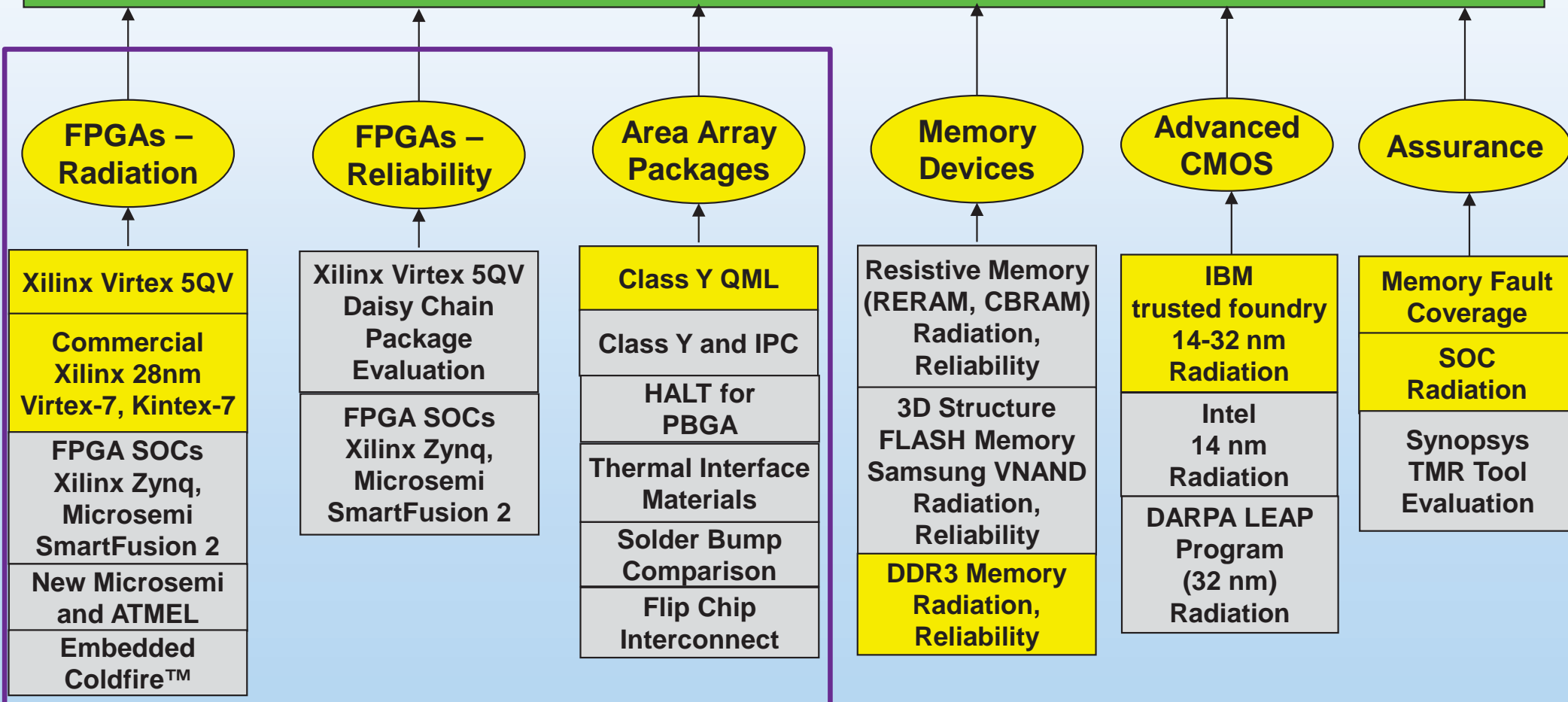 - Reliability: Doug Sheldon

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FY14 NEPP Core - Complex Devices

Core Areas are Bubbles;
Boxes underneath are variable tasks in each core

Legend

NEPP Ongoing Task
FY14 Proposed New Start

NEPP Research Category – Complex Devices

FPGAs – Radiation
- Xilinx Virtex 5QV
- Commercial Xilinx 28nm Virtex-7, Kintex-7
- FPGA SOCs Xilinx Zynq, Microsemi SmartFusion 2
- New Microsemi and ATMEL
- Embedded Coldfire™

FPGAs – Reliability
- Xilinx Virtex 5QV Daisy Chain Package Evaluation
- FPGA SOCs Xilinx Zynq, Microsemi SmartFusion 2

Area Array Packages
- Class Y QML
- Class Y and IPC
- HALT for PBGA
- Thermal Interface Materials
- Solder Bump Comparison
- Flip Chip Interconnect

Memory Devices
- Resistive Memory (RERAM, CBRAM) Radiation, Reliability
- 3D Structure FLASH Memory Samsung VNAND Radiation, Reliability
- DDR3 Memory Radiation, Reliability

Advanced CMOS
- IBM trusted foundry 14-32 nm Radiation
- Intel 14 nm Radiation
- DARPA LEAP Program (32 nm) Radiation

Assurance
- Memory Fault Coverage
- SOC Radiation
- Synopsys TMR Tool Evaluation

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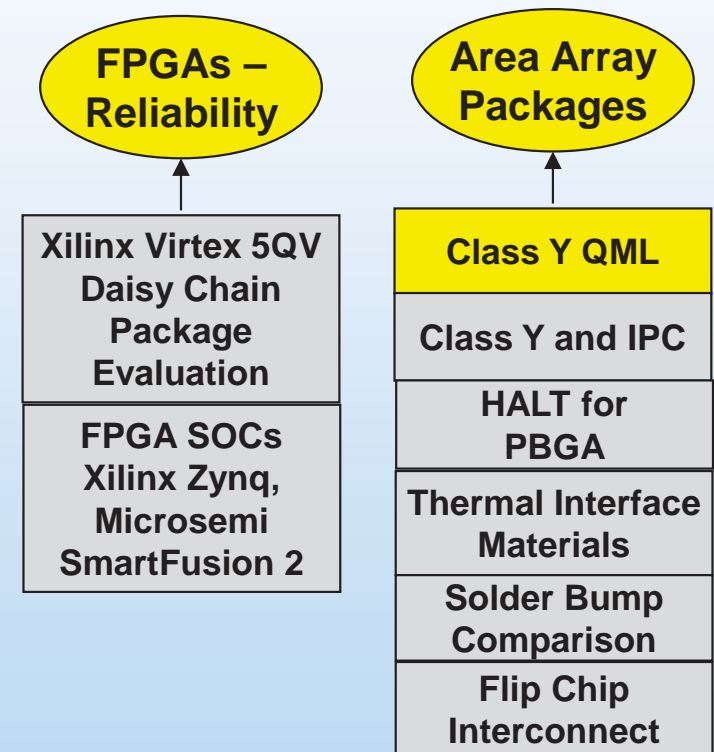
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Radiation Tasks

- ## Xilinx Virtex 5QV
  - See Melanie Berg's talk

- ## Xilinx Kintex-7 (Virtex-7 family)
  - SEE testing begun in April 2014 (Melanie Berg)

- ## Microsemi ProASIC
  - SEE Testing completed (Melanie Berg)

- ## Evaluation of mitigation tools
  - Under discussion with Synopsis to evaluate (Melanie Berg)

- ## Xilinx Zynq-7000
  - SEE testing begun (Farokh Irom)

- ## Discussions underway with Altera on next generation (Stratix 10) and Microsemi RT4G

FPGAs – Radiation

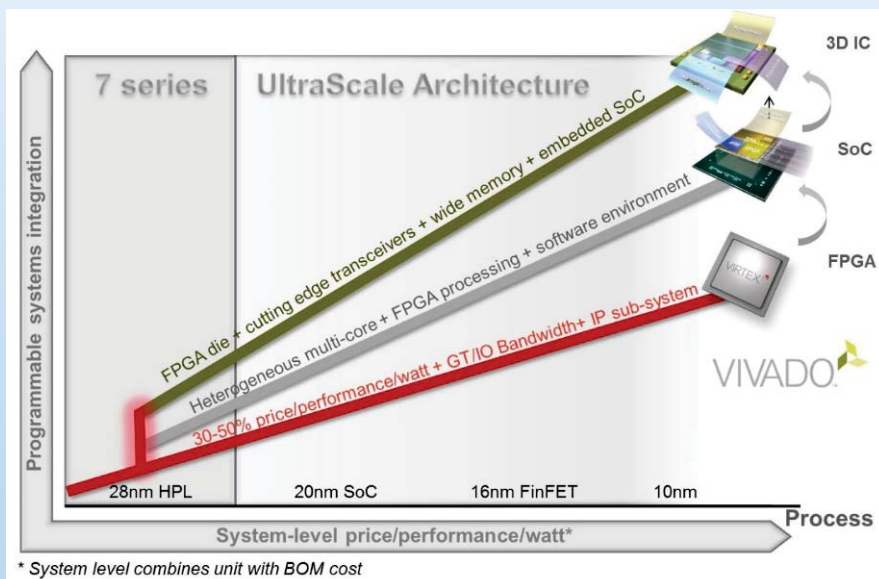| |
|---|
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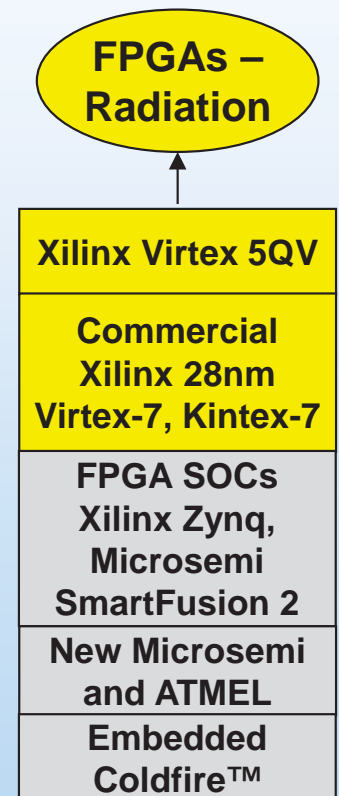
Reliability Tasks

- **Xilinx Virtex 5QV**
  - **Awaiting daisy chain packages**
- **Xilinx Artix-7 (Virtex-7 family)**
  - **See Doug Sheldon's talk**
- **HALT for PBGA**
  - **See Ram's talk**
- **Multiple BOK documents**

FPGAs – Reliability

| Xilinx Virtex 5QV Daisy Chain Package Evaluation |
| FPGA SOCs Xilinx Zynq, Microsemi SmartFusion 2 |

Area Array Packages

| Class Y QML |
| Class Y and IPC |
| HALT for PBGA |
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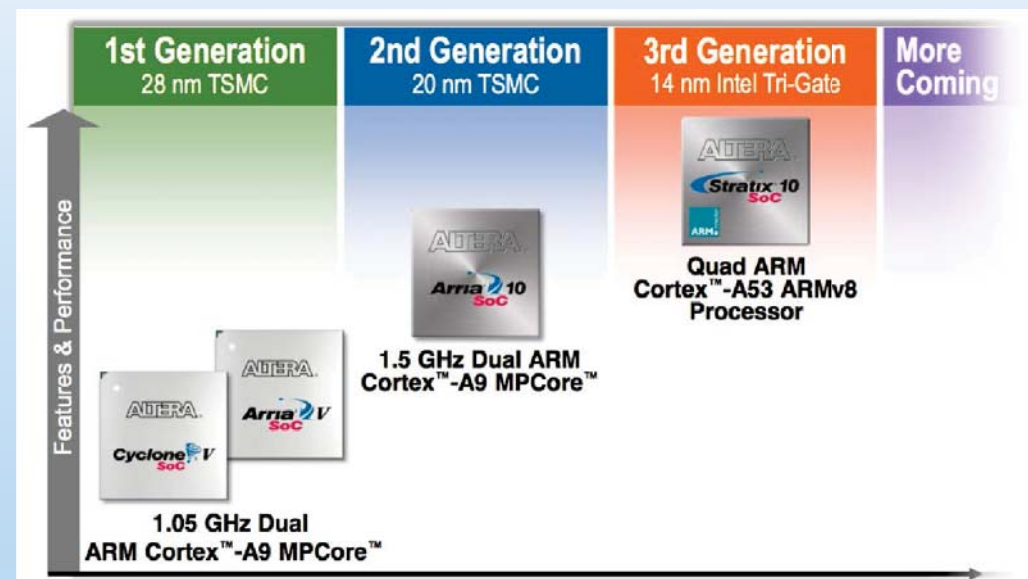
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Summary

- **FPGAs continue to be a major technology focus for NEPP for both Mil/Aero and commercial products**
  - **Applications will vary from ultra-reliable to "throwaway" CubeSats and everything in between.**

http://www.xilinx.com/about/generation-ahead-20nm.html

http://eecatalog.com/caciufo/wp-content/uploads/2014/01/Figure-5-Altera-SoC-roadmap-PNG.png

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